## REMARKS

In response to the Examiner's rejections under Sections 112, 102 and 103, applicants have cancelled original claims 1-8 and substituted new claims 9-12. Applicants submit that the new claims are clearly patentable over the prior art of record for the reasons discussed below. In addition, the rejections of original claims 3, 6 and 7 under the second paragraph of Section 112 should now be moot.

In response to the Examiner's objection to the drawings, applicants have submitted a new Figure 1 which more clearly depicts the dense vertical cracked "("DVC") structure inherent in the thermal insulating ceramic layer described and claimed in the application. The DVC layer is designated as item 12. Applicants submit that Figure 1, as revised, does not encompass any new matter and simply clarifies the nature of the DVC layer in accordance with the invention as described in the application.

Applicants also respectfully submit that new claims 9-12 are neither anticipated nor rendered obvious over the cited prior art references. Claims 9-12 focus on a critical and controlling difference between applicants' invention and structures resulting from other prior art processes for forming thermal barrier coatings. That is, three of the four cited references involve methods for forming the thermal insulating ceramic layer other than a dense vertically cracked technique. The fourth reference (the '539 patent to Farmer) relies on significantly higher weight percentages of Yttria-stabilized Zirconia in the ceramic coating. Applicants' specification makes clear that those prior art techniques do not achieve the same level of particle erosion resistance in the final coating, and

certainly do not form the same type of ceramic macrostructure, with or without lower threshold amounts of Yttria. *See, e.g.*, page 9 at paragraph 20.

The advantages of dense vertically cracked thermal barrier coatings can be attributed to the fact that they have a porosity level and a tensile strength higher than other conventional thermal barrier coatings (such as those formed by plasma spray). In addition, the dense vertically cracked procedure tends to produce a segmented ceramic structure that can serve as an effective strain release mechanism for the metallic/ceramic interface between the coated engine components and the thermal barrier coating. *See* the discussion of DVC in the '539 patent to Farmer. With DVC, the macrocracks formed in the coating are oriented substantially vertically. *See* new Fig. 1. For purposes of comparison, see also the ceramic layer 26 in Fig. 2 of the '788 patent which depicts the layer formed by EBPVD without vertical cracking.

Applicant's reference in the specification and claims to a "dense vertically cracked ceramic" is not simply a "process limitation" as the Examiner has assumed, but instead represents a defined structural characteristic of a new ceramic layer that adheres to a bond coating consisting of an oxidation-resistant coating of MCrAlY. The technique for creating dense vertically cracked thermal barrier coatings is known. By the same token, that technique differs from other known deposition methods, such as electron beam physical vapor deposition (EBPVD) or low pressure plasma spray (LPPS), electroplating or cathodic arc. Those skilled in the art would also recognize that the underlying structure will be different, depending on the exact technique and individual components being used. Thus, applicants respectfully disagree with the examiner's assumption that

the prior art plasma spray or EBPVD techniques will inevitably create the same end product. Different ceramic deposition techniques result in inherent differences in macrostructure and physical properties.

Moreover, none of the prior art of record, taken either alone or in combination, anticipates or renders obvious applicants combination of forming a dense vertically cracked ceramic layer having low threshold amounts of yttrium-stabilized zirconia (between 1-6% by weight, preferably 4%). Briefly, the differences between the prior art cited by the examiner and the present invention are as follows.

The '788 patent to Bruce et al concerns the use of EBPVD to produce a strain-tolerant columnar grain structure, thereby enabling the substrate coating to expand and contract without causing damaging stress that might lead to spallation. The patent is silent about the use of dense vertically cracked deposition to form the substrate. Although the '788 patent does refer, at col. 3, line 62, to "other known processes," it does not mention DVC, but instead cites only plasma spraying and low pressure plasma spraying. In addition, the '788 patent does not teach or suggest using DVC to improve particle erosion resistance.

The '898 Burns et al patent likewise does not teach using a dense vertically cracked deposition technique to create the thermal barrier coatings as described and claimed in the present application. The '898 patent describes using a mixture of zirconium oxide and about 3-25% yttrium oxide (or other stabilizers). The wide range of stabilizers mentioned in Burns et al certainly would not lead someone skilled in the art to select less than 6% by weight Yttria in combination with a DVC deposition technique. If

anything, the patent suggests that the best physical properties can be achieved using levels of stabilizing Yttria above 6% by weight. *See* col. 4, lines 57-60.

Although the '539 patent to Farmer refers to the possible use of a dense vertically cracked deposition technique, Farmer clearly teaches that the minimum amount of Yttria should be at least 8% by weight. *See* col. 3, line 56.

Finally, the '088 patent to Bruce et al also relies on EBPVD to form the ceramic topcoat, noting the advantages achieved by the resulting strain-tolerant columnar grain structure. Again, the patent does not specifically recognize the advantage of improved particle erosion resistance resulting from applicants' dense vertically cracked ceramic layer using low threshold amount of Yttria-stablized Zirconia.

In view of the foregoing amendment and remarks, applicants respectfully request prompt reconsideration and early allowance of claims 9-12.

Respectfully submitted,

**NIXON & VANDERHYE P.C.**

By: _____
James T. Hosmer
Reg. No. 30,184

JTH:lsp
1100 North Glebe Road, 8th Floor
Arlington, VA 22201-4714
Telephone: (703) 816-4000
Facsimile: (703) 816-4100